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(54) PORTABLE MACHINES HAVING VIBRATION ABSORBING DEVICES

(71) We, SAKURA DENKI KABUSHIKI KAISHA, a Japanese Corporate Body, of 241 Shimadacho, Ashikagashi, Tochikgi, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in the following statement:

This invention relates to portable machines incorporating vibration absorbing devices.

It is known to impart fluidity to raw concrete which has been poured into a mould so as to fill the mould corners by inserting a stick-like vibrator into the concrete. There are two types of such vibrators known; in one an unbalanced weight is attached to the shaft of a small size motor, the shaft being housed in a sleeve casing, and the shaft is rotated at a high speed; in the other an unbalanced weight shaft is housed alone in the casing and the rotational movement is transmitted from an outside source to the shaft via a hose housing a flexible shaft joined to the rear end of the casing.

In any event, the effective radius of these types of concrete vibrator becomes bigger proportionate to the slump of concrete and —to the accelerated speed of vibration. This accelerated vibration naturally varies in proportion because the second power of vibrational number (rotational speed) is multiplied by the amplitude of vibration. Thus, the effective range of vibration increases with increased number of vibration. A generally used range is 7,000-10,000 rpm for the vibrational number and 1-3 mm for amplitude. Many such concrete vibrators are of a small size, for example one-man operated portable machines with a total weight not exceeding 20 kg. Even a very large machine would require only two operators and is portable.

Such vibrators have as a source of vibration either an electric motor incorporated within the machine body or an outside power source, as discussed above. The vibrator is joined to the outside power source such as a portable generator, or an internal combustion engine or an outside prime mover, either by a cable for supplying the current or for controlling such a supply, or by a flexible hose through which is inserted the flexible shaft. In other cases a hose coupling is attached directly to the machine body of the vibrator and joined to the flexible hose. Whichever mode of connection, the vibration of the machine body causes premature fatigue and damage to the portion where the hose coupling is joined to the flexible hose, and also has undesirable effects on the health of operators since they are subjected directly to the vibration.

Comparatively large sized concrete vibrators comprise a machine body including the source of vibration having a support means attached thereto through a yielding rubber, a hose coupling to connect the operating bar handle and the flexible hose, and a cable for passing the current or a flexible shaft inserted through the support means and the yielding rubber and into the machine body. The yielding rubber directly receives the vibration from the machine body which results in an early fatigue and requires frequent replacement of rubber. This involves additional costs and labour in maintenance.

Various difficulties explained above are encountered in machines other than concreate vibrators, for example rock drills, drills, rivet guns, chain saws, and lead to such occupational disease, such as chain saw disease. Although various vibration absorbing means to cut off vibration transmission to operators of these vibrator machines of portable type have heretofore been proposed, there has not yet been pro-

posd a means which sufficiently supports the weight of the machine and the reaction force during operation and at the same time effectively attenuates the vibration.

In accordance with the invention there is provided, a portable machine comprising an operating part which in use vibrates, a handle for holding the machine, and a vibration-absorbing joint which connects the operating part to the handle, wherein the joint comprises a plurality of enlongate, resilient members arranged about and spaced from the axis of the joint and extending longitudinally thereof, each member having a wavy or corrugated shape defining ridge and being on a radial plane which contains the axis of the joint with the ridge projecting in a radial direction, and the members being connected at opposite ends to the handle and the operating part, respectively.

The portable machine may, for example, be a concrete vibrator, a rock drill, a drill, a rivet gun or a chain saw, all of which have accompanying vibrations during use.

The resilient members may be small diameter round or rectangular steel rods or bars and preferably each member is fixed at its ends to top and bottom annular members. Accordingly, by fixing these top and bottom annular members of the joint respectively to the machine body and to handle, the machine body and the handle are joined to each other by the cylindrical joint. Thus, even when it is necessary to insert into the machine body a power cable or a flexible shaft, the flexible hose encasing such a power cable or flexible shaft may be inserted through the joint and through the bores of the top and bottom annular members.

Two forms of vibrator having a vibration absorbing device in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which: —

Figure 1 is a vertical cross-section of one form of concrete vibrator;

Figure 2 is a cross-section taken along the line II-II of Figure 1; and

Figure 3 is a front view of the other form of vibrator, a part of which is shown in cross-section.

The forms of vibration absorbing device described below are both incorporated in portable concrete vibrators encasing a motor therein. The vibration absorbing devices may however be applied to various types of portable vibrating machines such as a chain saw or a rock drill, and act to radically reduce the vibration transmission to the handle from the machine body which has the source of vibration incorporated therein.

Figures 1 and 2 show the machine body 1 of a vibrator encasing an electric motor consisting of an unbalanced weight 2 positioned at its lower end and a rotor 3 and a stator 4 joined directly to the weight. Within the top cover 5 is arranged a terminal assembly 6 for the motor with the cable 7 joined to each terminal. The vibration absorbing device in the form of a joint 8 comprises a plurality of elastic or resilient rods or bars which form a tubular basket-like structure each bar being wavy or corrugated and defining at least one ridge on a radial plane including the directions of radius and of axis of the joint 8. In other words, each of the bars 9 is equally spaced apart on the periphery of the basket so that their ridges project radially as shown in Figure 2, and thus the profile of a plurality of the bars joined together becomes a corrugated tubular basket-like structure. The extremities of the ridges all lie in a plane which is perpendicular to the axis and transverse of the joint, i.e. the plane of the paper in Figure 2.

One end of each of the bars 9 is fixed by any suitable means such as welding to the top cover 5 by a ring member 10. A hose coupling 11 has a through hole 19 for letting the cable 7 pass and is joined to a flexible hose 13 to allow the cable 7 to pass therethrough and be protected. The flexible hose 13 leads to an outside source of power not shown in the drawings. The bars 9 are designed in such a manner that the size and the number of the bars are determined in advance to achieve enough mechanical strength to cope with the force of vibration of the machine body 1 and the reaction force as the machine is inserted into concrete. The circular or rectangular rods or bars 9 of desired material such as spring steel are bent with a predetermined curvature depending on the properties of the vibrator in order that they may function as a vibrator absorbing joint of a cylindrical basket shape.

In operation, an operator manipulates the vibrator by holding the machine in the vicinity of the hose coupling 11. Almost all the vibrations of a vibrator occur in the radial direction and they are absorbed as the bars 9 function as a vibration absorbing body with their resiliency in the radial direction. Thus, the joint comprising of bars 9 arranged radially as shown in Figure 2 will function as a vibration absorbing body in all the directions of radius, i.e. through 360°.

In the above-described vibrating machine, the vibration which would otherwise have been transmitted to the house coupling handle 11 from the machine body is, accordingly, attenuated sufficiently. Neither the operator who is holding the handle

nor the flexible hose would be subjected to any violent repeated vibration so that chances of discomfort to operator or of early fatigue to the material are greatly eliminated.

Figure 3 shows another form of vibration absorbing device used in a different concrete vibrator. The vibration absorbing joint 8′ comprises of a plurality of bars 9 each of which has one more ridge than the bars of the joint 8 of Figure 2. The vibrator has a head 15 provided with a bar handle 14, 14′ for holding the machine. A flexible hose 13 is connected through the intermediary of a protecting metal 16 to one end of the handle 14, and the cable 17 passes to the machine body from the vibration absorbing joint 8′ through a triple-pole switch 17 in the head 15. In this embodiment, the operator holds the bar handle 14, 14′ and starts the vibrator as he manipulates the knob 18 of the switch 17. Continuous vibration from the machine body does not reach the head 15 as it is sufficiently absorbed by the vibration absorbing joint 8′. Thus, neither the operator holding the handle 14, 14′ nor the flexible hose 13 is subjected to any strong vibrations nor to any early fatigue.

As has been explained in detail, the above-described vibration absorbing joint, which comprises the tubular basket-like structure with a plurality of bars, absorbs efficiently continuous violent vibrations from the machine body of the portable vibrator; prevents or reduces elastic failure of the flexible hose or the yield rubber connected to the machine body; and attenuates the vibration to which the operator is subjected, thereby protecting his health. Thus, the device is very useful, but does not complicate the construction of the vibrating machine to which it is filled.

The above-described vibration absorbing devices have the advantages that they decrease the material fatigue caused by vibration, and also will effectively attenuate the vibration transmission from the machine body to the flexible hose and to the operator; they have a sufficient strength to support the machine body; they may be incorporated easily in conventional portable machines and which will securely support the vibrating machine body by its handle and shut off the vibration transmission effectively.

In the above-described devices, since the ridges are arranged radially in the direction of radius away from the joint axis, the vibration is effectively absorbed in all the directions three dimensionally at the cylindrical basket instead of being transmitted from the machine body to the handle. By joining the handle and the machine body with such a cylindrical basket-shaped joint, the basket joint acts to enhance the strength as the operator holds the handle to support the machine body via the vibration absorbing joint.

Vibration absorbing efficiency and holding strength of the joint may be determined arbitrarily by selecting the material, thickness and number of bars as well as the amplitude and dimension of the corrugation in accordance with the specification.

WHAT WE CLAIM IS:—

1. A portable machine comprising an operating part which in use vibrates, a handle for holding the machine, and a vibration-absorbing joint which connects the operating part of the handle, wherein the joint comprises a plurality of elongate, resilient members arranged about and spaced from the axis of the joint and extending longitudinally thereof, each member having a wavy or corrugated shape defining a ridge and being on a radial plane which contains the axis of the joint with the ridge projecting in a radial direction, and the members being connected at opposite ends to the handle and the operating part, respectively.

2. A machine according to claim 1, wherein the extremities of adjacent ridges of adjacent members all lie in a single transverse plane which is perpendicular to the axis of the basket.

3. A machine according to claim 1 or 2, wherein each ridge projects radially inwardly.

4. A machine according to any of claims 1 to 3, wherein the members are fixed at their ends to two annular members, one at each end of the joint, so that the annular members and the joint have a through hole for a hose or cable.

5. A machine according to any of claims 1 to 4, wherein the ridge on each member is one of a plurality of such ridges formed on that member.

6. A machine according to any of claims 1 to 6, wherein each member is formed of spring steel.

7. A portable machine constructed and arranged substantially as herein described with reference to Figure 1 or Figure 2 of the accompanying drawings.

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1567610 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG.1

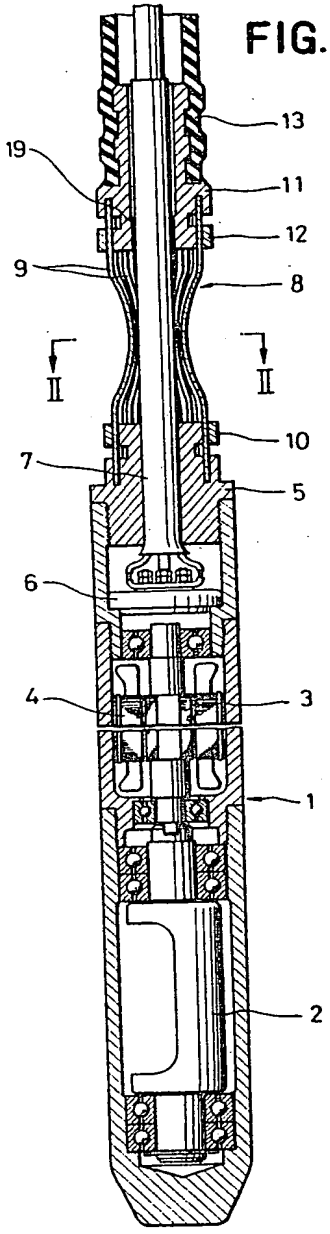

FIG.2

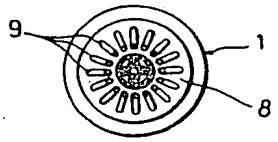

FIG.3